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ALABAMA AGRICULTURAL AND MECHANICAL UNIVERSITY KSU/Nor...

Normal, Alabama 35762

DEPARTMENT OF NATURAL RESOURCE AND
ENVIRONMENTAL STUDIES

January 10, 1974

Beverly J. Hungerford
Grant Administrator
National Aeronautics and
Space Administration
Washington, D. C. 20546

Dear Mr. Hungerford:

Enclosed please find a copy of the "final technical report" and the "cumlative cost expenditure report" required to close out NASA grant NGR 01-001-014.

No items were purchased costing more than $1,000; there is no residual equipment or property which was furnished by the Government; no inventions were invclved; and no classified materials were involved; so no items relating to these have been prepared.

Please advise if any additional information is needed.

Sincerely,

G. C. Sharma
Principal Investigator

Michael S. Golden
Associate Investigator

GCS:mlg

Enclosure

cc: W. Thomas
D. I. Horn
M. Blundell

FINAL TECHNICAL REPORT

Application of Remote Sensing In Agriculture and Forestry and Ground Truth Documentation In Resource Planning

(NASA NGR-01-001-014)
May, 1971 to May, 1974

Department of Natural Resources
Alabama A&M University

January 4, 1974

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Introduction

These studies were initiated in May, 1971 under the support of NASA grant NGR 01-001-014, administered through the NASA University Affairs office at Marshall Space Flight Center, Huntsville, Alabama.

The first 15 months were concerned primarily with cooperation and ground truth support relating to a land use study by the Environmental Applications office at Marshall Space Flight Center. Emphasis then shifted to forestry-related studies, which continued through the duration of the grant period. Certain of these forestry-related studies are continuing through the aid of NASA grant NGR 01-001-023.

The following report is a description of these activities and a summary of their findings.

Southern Pine Beetle Study

Study was initiated in August, 1972, to determine the applications of remotely sensed data for the detection of areas infested by the southern pine beetle (Dendroctonus frontalis).

Multispectral imagery of the Guntersville area was studied to observe the appearance of beetle outbreaks. A heavily infested area near Auburn was suggested by the Alabama Forestry Commission as a study site. Due to adverse wheather, multispectral imagery of the area was not obtained until November 4, 1972. Working with Sanford Downs of NASA, a mosaic of the study area was prepared and suspected beetle-infested trees were located and marked.

Golden and Downs field checked the study area on November 13 and 14. The coorelation between the four-lens 1:24,000 scale imagery and ground truth was determined, and the red spectral band was found to be of greatest use.

Great difficulty was encountered in distinguishing on the imagery between beetle-killed pines and hardwoods with fall coloration, although field experience with the imagery in hand increased proficiency. Mid-winter or mid-summer imagery is recommended in order to reduce this difficulty.

The Alabama Forestry Commission has been conducting overflights in the state to detect and assess damage from the southern pine beetle. These overflights have utilized two observers marking damage locations on maps while flying at low altitudes. It has generally taken at least a month to cover the high-infestation areas of the state.

Study was initiated in early 1973 to determine the utility of high altitude small-scale photography for the purpose of detecting and assessing beetle-damaged trees. If feasible, the use of the smaller scales could result in substantial savings in flying and interpretation time and costs.

Infrared color imagery including coverage of Marshall County was taken in February, 1973. It was obtained from a U-2 aircraft at 65,000 feet altitude using a wild RC-8 with a 12 inch focal length. Contact scale of the transparencies was 1:130,000.

By careful study with a Bausch and Lomb zoom 240 stereoscope (magnification up to 30X) it was possible to locate clusters of beetle-damaged pines. In many places however, this was difficult or impossible because of confusion of dead pines with leafless hardwoods, several ground checks were made in Marshall County to confirm these results.

ERTS Studies

Limited investigations were conducted in 1972 and 1973 to assess the utility of ERTS multispectral scanner data for forestry and natural resource applications.

Through detailed visual inspection and ground checking it was possible to separate coniferous (pine) forest stands from non-coniferous stands. Three band (bands 4, 5 & 7) color composites from late December 1972 data were most useful for this purpose. Stands as small as four acres were delineated.

Efforts to detect southern pine beetle infestations using ERTS imagery (studied visually) were fruitless. Low resolution of imagery, small infestation size and mixed vegetation types made the use of ERTS imagery impractical for

this purpose in the north Alabama area.

Physiographic Site Classification

Preliminary plans for the intensive study of the utilization of high altitude and space imagery for the physiographic classification of forest land were formulated. The objective is to use remote sensing data to classify forest land into units that are relatively uniform as to climate, geology and land-form. The emphasis is to be on classification into units that have value for land managers in making use or management decisions. A map delineating these units can then be produced from high altitude and/or space imagery. Preliminary study indicated that 1:120,000 scale imagery has great potential for these purposes.

Consultation was made with Drs. E. J. Hodgkins and E. W. Johnson at Auburn University and Dr. Nelson Loftus of the U. S. Forest Service Silvicultural Laboratory at Sewanee, Tennessee. These men showed considerable interest in this work and offered valuable advice and cooperation.

Field investigations were begun in selected areas of northern Alabama to determine variability within various landscape classes.

Land Use Classification

During the year May 1971-1972 Alabama A and M University assisted the Environmental Applications Office at Marshall Space Flight Center (hereafter called EA/MSFC) in a land use determination study of the TARCOG area (Top of Alabama Regional Council of Governments, a resource planning agency for the Madison, Limestone, DeKalb, Jackson, and Marshall counties). A description of activities is presented below:

a. Ground Truth Documentation:

As the aerial photography progressed in the TARCOG area, senior re-research personnel and student assistants traveled extensively in the area to become familiar with the vegetation cover. In addition to several spot checks the following locations were selected for intensive

data and ground truth collection.

	Location	No. of ground truth documentations	Dates of sequential documentations
1.	Alabama A&M University Research and Production Farms	3	4/14/71 6/8/71 7/16/71
2.	TVA Substation-Belle Mina Auburn University	3	4/10/71 6/17/71 7/15/71
3.	Sand Mountain Substation Auburn University	3	10/13/71

More than one ground truth determination of these areas (all larger than 300 acres) was essential in order to assist photointerpretation by closely observing the changes in growth characteristic of agricultural and other natural ecosystems. It is suggested that a similar procedure be followed in the future. Information obtained from detailed ground truth were compiled in line maps.

b. Development of a land use classification system:

Categorization and mapping of the information related to present land occupation depend upon a well defined land use classification system. Land use classification systems have been developed in the United States and elsehwere. Most of these classification systems were adapted to local needs and hence were not appropriate for direct use in the TARCOG study without some modification. Recently, a realization of the application of space technology to resource planning has hastened the need of a uniform national land use classification system.[1]

With the above discussion in mind, Alabama A&M University personnel in cooperation with the scientists from EA/MSFC worked towards arriving

[1]U. S. G. S/NASA Conferences on land use information and classification, June 28-30. G. S. A. auditorium bldg., Washington, D. C. (Arch Gerlach, U. S. G. S., organizer).

at a land use classification system for the TARCOG area. The classification system was intended to meet the following requirements:

a. It should meet the specific needs of the TARCOG study;

b. It should conform to the national effort towards a uniform land use classification system.

c. It should be applicable on a state-wide or regional basis with minimum modification.

A detailed land use classification system was developed and since then it has been revised three times.

Forest Types and Species Delineation

Planning and acquisition of ground truth data for the purpose of separating forest types on multispectral imagery began in August, 1972. Three areas in Northern Alabama were selected for study. These were:

1. Clear Creek watershed (Jackson County).

2. Chapman Mountian-Monte Sano State Park area (Madison County).

3. Bee Branch area in Bankhead National Forest (Lawrence County).

Data on tree species distribution and size, and site characteristics were obtained from these areas. The Tennessee Valley Authority and the U. S. Forest Service were cooperative in providing information and data where possible.

Fall multispectral imagery of the areas at altitudes of three and six thousand feet was obtained on November 5 and 7, 1972. Due to malfunction in the camera system, this imagery was somewhat blurred and its usefulness was quite limited.

SUMMARY

A number of investigations were made regarding the use of remotely-sensed data for natural resource applications. These included:

(1) Investigations using varied small-scale imagery for detecting and assessing damage by the southern pine beetle. Fall multispectral imagery (1:24,000 scale) proved very difficult to use for beetle detection because

of the confusion of deciduous trees (with autumn foliage coloration) with damaged pines. Judging from a study of winter infrared imagery at 1:130,000 scale, it seems possible that small scale imagery may prove useful for beetle damage detection and assessment during the active growing season. Winter use was limited because of confusion of dead pines with leafless hardwoods.

(2) Studies of the usefulness of ERTS scanner imagery for vegetation classification and pine beetle damage detection and assessment. It was found possible to segregate (visually) pine stands larger than four acres from surrounding non-coniferous vegetation. Due to low resolution, detection of pine beetle damage was not possible in north Alabama.

(3) Planning and preliminary field work for the utilization of small-scale imagery for forest land classification.

(4) Ground truth acquisition and mapping for the development of a land use classification system for the TARCOG area.

(5) Preliminary ground data acquisition for forest type identification using multispectral aerial photographs. Camera malfunction during imagery acquisition resulted in imagery which was of very limited value for forest type identification.

Work regarding the use of small scale imagery for southern pine bettle detection and damage assessment and for forest land classification is being continued under NASA grant NGR 01-001-023.